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Add Peanut to Corn-Cotton Relay Cropping System

Nopporn Sayampol[1] and Sodsai Changsalak[2]

ABSTRACT

Annual crops, soybean, vegetable soybean, mungbean, peanut and sesame were tried as double crops with corn or cotton or both in typical corn-cotton relay cropping system of Kanchanaburi Province, where spacing between rows for corn and cotton were wider than recommended for sole crop. During 1994-1996 experiments, row and hill spacing and number of plants per hill of corn, cotton and short annual crops were varied in order to find suitable cropping systems, which gave maximum net income. Cotton varieties used in 1994, 1995 and 1996 were IRCT 413, IRCT413, and Sri Sumrong 60 (SSR 60), respectively. The maximum income was obtained from glutinous corn grown as sole crop with spacing of 0.5 x 0.25 m, one plant per hill, followed by double planting of one row of SSR 60 and 3 row of peanut, with spacing of 1.5 m between cotton rows. Optimum spacing between hills of cotton was 0.5 m with two plants per hill, while spacing between hills of peanut was 12.5 cm with two plants per hill.

Key words: relay cropping, plant spacing, corn, peanut, cotton

INTRODUCTION

A sharp decrease of cotton production in Thailand since 1982, with a 14% decreasing consumption in 1992, had accelerated an attempt of collaborations between researchers and extensionists to find suitable systems of production for cotton farmers. Naritoom *et al.* (1992) studied agricultural production systems of Kanchanaburi Province where cotton was planted in large area and pointed out that new cotton varieties with higher yield and better resistance to insect pests should lead to sustainability of maize-cotton relay cropping system. Castella *et al.* (1992) have analyzed farmer production methods in the same area and found that the farmers planted glutinous corn (table corn) in early rainy season. About one week before table corn harvested, cotton was sowed alternately to corn rows which were about 1.2 to 1.7 m apart. Big farmers planted feeding corn in the remaining area: in this case, cotton was grown under corn for about one month. They found not only the problem of pest management techniques but also "taokaes-farmers" relationship that leaded to high input waste and made these production systems less sustainable.

Trebuil *et al.* (1992) introduced 3 new cotton varieties and after 2 consecutive years. They concluded that among these varieties, IRCT 143 was the best adapted to condition of Thailand. It gave better fiber quality and percent ginning out turn than Sri Sumrong 2 (SSR 2) and Sri Sumrong 60 (SSR 60). Its seeds contained no gossypol, which could be directly used in food industry.

1 Department of Agronomy, Faculty of Agriculture, Kasetsart University, Bangkok 10900, Thailand.

2 DORAS Center, Kasetsart University, Bangkok 10900, Thailand.

Though IRCT 413 had lower yield, this could be compensated with higher price (up to 25% more as indicated by President of Thai Cotton Industry Society) according to high product value which led to more income to farmers and increase cotton quality.

Due to wide space between corn and cotton rows it may be possible to introduce a cropping system giving higher adding some double crops to corn, or cotton, or both and using IRCT 413 instead of SSR2 or SSR 60.

MATERIAL AND METHODS

The experiments were conducted in 1994, 1995 and 1996 at Suwan Experiment Station, Pakchong, Nakhon Patchasima Province. Soil type was Oxic Paleustults clayey, kaolinitic of middle to high acidity. Average annual rainfall is 1,000-1,200 mm. Experimental design in 1994 was a split-split plot in RCB with 4 replications. Main plots were two corn types: baby corn (Suwan 2) and table corn (Super Sweet DMR) planted early in rainy season (April 7) with a spacing of 0.75m between row. Sub plots were cotton (IRCT 143) planted next to corn with row spacing of 1.0 and 1.5 m. Sub-sub plots were corn intercrops which were soybean (Nakhonsawan 60), vegetable soybean (KPS 292), mungbean (KPS 2), peanut (SK 38), and sesame (KU 18). These were planted alternately to corn rows and no intercrop. SSR 60 without corn intercrop was added as check for farmer's traditional maize-cotton cropping system. Plots were 4 cotton rows of 10 m length. After corn harvesting, glyphosate was applied with 400g ai. per rai, then cotton was planted 7 days later. Hill spacing and number of plants per hill were as follows: table corn-25 cm, 1 plant/hill; baby corn-25 cm, 2 plants/hill; soybean-12.5 cm, 2 plants/hill; vegetable soybean, mungbean and peanut-12.5 cm, 1 plant/hill; sesame-10 cm, 1 plant/hill and cotton-50 cm, 1 plant/hill.

In 1995, two experiments were conducted. Split-split plot design in RCB with 4 replications were used in experiment 1. Each plot was composed of 3 cotton rows of 15m length. Main plots were two cotton varieties, IRCT 413 and SSR 60. Sub plots were two corn types: baby corn (Suwan 2) and table corn (glutinous corn). Sub-sub plots were two corn intercropped with peanut (SK 38) and sesame (KU 18). Corns and intercrops were planted on April 1, 1995. One week prior to corn harvesting, plots were hand-weeded and cottons were planted 15 cm from center of corn row. Hill spacing and number of plants per hill were similar to 1994 experiment, except that cottons were thinned to 2 plants per hill. Peanut and sesame were planted on May 15 and May 25, 1995, respectively.

For the second experiment, 2 x 2 factorial design in RCB with 4 replications were used. Each plot consisted of 4 cotton rows of 17 m. Factor 1 was two cotton varieties, i.e. IRCT 413 and SSR 60, planted with row spacing of 1.5 m and hill spacing of 0.5 m with two plants per hill. Factor 2 was two cotton intercrops which were peanut (SK 38) and sesame (KU 18). Cotton was planted on June 30, 1995, whereas two rows of peanut or sesame were planted 50 cm and 35 cm apart, respectively, between cotton rows. Hill spacing of peanut and sesame were similar to the first experiment.

In 1996 twelve cropping systems (Table 1) were planted using a RCB design with 4 replications. Three cotton rows of 22m length for each plot were planted on April 25, 1996. Glutinous corn and SSR 60 were used. Intercrop was peanut (SK 38), sesame (KU 18) and vegetable soybean (Chiangmai 60). Hill spacing and number of plants per hill were as follows: table corn and cotton-similar to 1995; peanut and vegetable soybean-12.5 cm, 2 plants/hill; sesame-10 cm, 2 plants/hill.

Cotton was planted on June 2, 1996, i.e. 27

Table 1 Twelve cropping systems in which table corn and cotton were main crops and peanut (PEA), sesame (SES) or vegetable soybean (VS) were interplanted with table corn or cotton or both crops.

System No.	Table corn row Spacing (m)	Table corn Intercrop	Cotton row Spacing (m)	Cotton Intercrop
1	0.75	-	1.5	PEA 2 rows
2	0.75	-	1.5	VS 2 rows
3	0.75	-	1.5	PEA 3 rows
4	0.75	-	1.5	VS 3 rows
5	1.0	PEA 2 rows	1.0	-
6	1.0	SES 2 rows	1.0	-
7	1.0	VS 2 rows	1.0	VS 2 rows
8	1.25	PEA 3 rows	1.25	-
9	1.25	SES 3 rows	1.25	-
10	1.25	VS 3 rows	1.25	VS 2 rows
11	1.25	VS 3 rows	1.25	VS 3 rows
12		1.25	VS 3 rows	1.25 -

days before harvesting corn, for system no. 1-6 and no. 8-9, and July 21, 1996, i.e. just after harvesting vegetable soybean, for system no. 7 and no. 10-12.

Height of each crop was measured weekly and used as criteria of growth. One, two or three middle rows of each crop were harvested and yield was recorded accordingly. For table corn, the observed trait was number of ears of each size. Baby corn trait was weight of ear with husk. Vegetable soybean (KPS292) trait was fresh pod. Vegetable soybean (CM 60) trait was fresh pod with stem. For soybean, mungbean and sesame, the observed traits were dry seed weight. Peanut traits were fresh pod and dry seed weight. Cotton trait was seed cotton weight. Net income per rai for each crop were calculated using the following product prices: corn at 1.00, 0.70 and 0.30 Baht per ear for big, medium and small sizes respectively, baby corn with husk at 2.75 Baht per kg, vegetable soybean at 1 Baht per kg, soybean, mungbean, peanut and sesame at 8.50, 9.50, 14.00 and 8.50 Baht per kg. Labor cost was estimated from average wage in Kanchanaburi Province.

For all experiments, alachlor at the rate of 300g a.i. per rai was applied as pre-emergence herbicide. Fertilizers were applied at planting and top dress. Baby corn received 25 kg of 16-0-0 per rai at planting. Table corn received 25 kg of 15-15-15 per rai at planting and 25 kg of 21-0-0 per rai at 40 days after emergence. Mungbean, peanut, soybean and vegetable soybean received 25 kg of 15-15-15 per rai at planting. Vegetable soybean received 12 kg of 15-15-15 per rai at 15, 30 and 45 days after emergence. Cotton received 30 kg of 15-15-15 per rai at planting and 10 kg of 21-0-0 per rai at 45 days after emergence.

RESULTS AND DISCUSSION

In 1994, it was found that baby corn

intercropped with vegetable soybean, mungbean, no intercrop and peanut gave high yield (924, 919, 919, and 897 kg/rai, respectively), but gave lower yield when intercrop with soybean (883 kg/rai) and sesame (746 kg/rai). These differences were not found for table corn based system. Height of baby corn and table corn with and without intercrops was not significantly different throughout the growing periods. Vegetable soybean, mungbean, peanut and sesame which were planted alternately to baby corn row gave higher yield than to table corn rows. No difference was found in soybean. Height of most intercrops, except sesame, were the same when growing with baby corn or with table corn, and for most intercrops yields when planted between baby corn rows were higher than these of table corn rows, except soybean which gave equal yields. Growth and yield of cotton variety IRCT 413 planted after corn with or without intercrops were not statistically different. Cotton interrow spacing showed an effect on cotton yield in which 1.0 m interrow spacing gave higher seed-cotton yield, although row spacing of 1.5 m cotton had more fruiting branches per plant (24 compared to 22 branches), more bolls on vegetative (66 compared to 49 bolls) and fruiting branches (20 compared to 17 bolls) and higher bolls per plant (26.6 compared to 22 bolls). Cotton planted next to baby corn on July 14, 1994, gave higher yield. Net incomes of top 10 cropping systems were shown in Figure 1. One could notice that cropping system, which consisted of table corn and using narrow cotton rows spacing gave high total net profits. Though similar experiment conducted during the sane period on farmer fields at Saiyoke District, Kanchanaburi Province, showed the same results, most farmers were not familiar with such narrow cotton rows and were worried about insecticide application efficiency. Moreover, rainfall could damage dry seed crop. Therefore, it might be more reasonable for Kanchanaburi's farmers to grow peanut which can be sold as fresh pod or dry seed. Among SSR 60 treatments with no intercrop, the 1.0 m between cotton rows gave the highest seed cotton yield which was 20.8% higher than IRCT 413 in combination of TC-VS- 1.0 (Figure 1). However, with higher ginning-out-turn and fiber quality of IRCT 413 compared to SSR 60, ginners would buy pure IRCT 413 seed cotton at 25% higher price than SSR 60. This would partly compensate lower yield of IRCT 413.

In 1995, cotton row spacing was altered to 1.5 m while plants per hill were increased to 2 plants, so population of cotton was increased to 4,267 plants per rai comparing to interrow 1 meter and 1 plant per hill which gave rise to 3,200 plants per rai. Peanut was used as both corn and cotton intercrop because of its tolerance to shade. Sesame was also studied because it need less labor for harvesting which is suitable for big farms. In 1995, the results showed that there were no difference on height and yield of baby corn and table corn when intercropped with peanut and sesame. But yields of the two intercrops were higher when planted with table corn than baby corn. Peanut and sesame planted with baby corn were taller than planted with table corn at 42 to 45 and 42-65 days after emergence, respectively. Then there was no difference on growth until harvesting. These might result from higher population of baby corn than table corn.

Cotton planted before table corn harvesting was higher than that planted before harvesting baby corn during 29 to 92 days after emergence with shorter flowering date (62.3:66.4 days) and lower seed cotton yield (290:324 kg/rai). This might be because growth of young cotton under high population of baby corn is slower than that under lower population of table corn and cotton planted after baby corn had 10 days of vegetative growth longer than cotton planted after table corn. There was no effect of intercrop on seed cotton

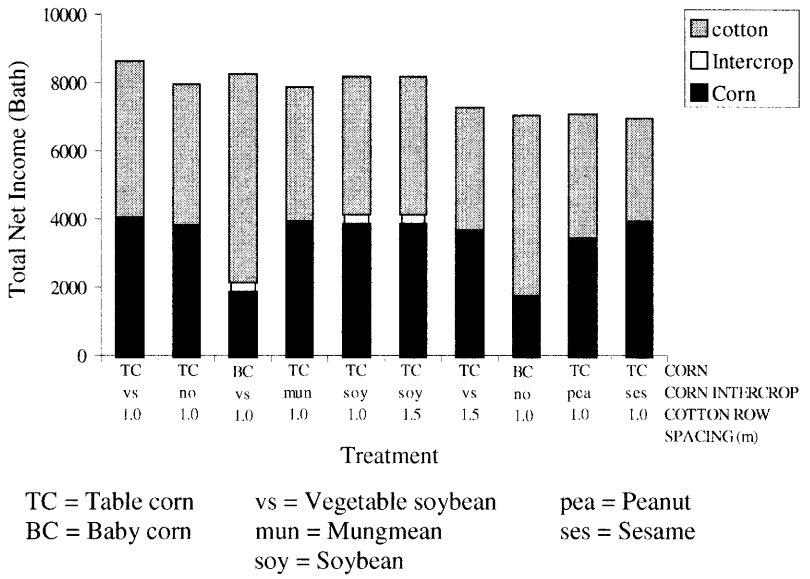

Figure 1 Total net income and crop net income of 10 cropping systems in 1994.

yield. Height of cotton planted next to corn with sesame was higher than corn with peanut during 29 to 105 days after emergence. SSR 60 gave higher seed cotton yield than IRCT 413 for all cropping systems with the same kinds of corn and corn intercrop (Figure 2). This resulted in greater net income from peanut than from sesame.

Greater income from table corn than baby corn caused the system of table corn with peanut followed by SSR 60 cotton to be the highest profitable.

The results of experiment 2 showed no significant difference on growth, flowering date and seed cotton yield on each cotton variety when intercropped with peanut and sesame. Cotton varieties also had no effect on growth and yield of each intercrop but SSR 60 gave higher seed cotton yield than IRCT 413. These results led to the possibility of adding intercrops to corn and cotton in farmer's traditional maize-cotton cropping system without disturbing corn and cotton yields when row spacings of corn and cotton were 1.5 m.

In 1996, table corn planted as sole crop (i.e. 0.5 x 0.25 m, 1 plant per hill), gave higher yield than other spacings with or without intercrop. Late cotton planted on July 22 yielded much less than earlier planting on June 2 (99 compared to 215 kg/rai, at cv = 38.7%) because early planting cotton (system 1-6 and 8-9) had 5 months of vegetative growth under adequate rainfall, (i.e. less early growth and more later), but late planting cotton (systems 7 and 10-12) had received much rain during early growing period and amount of rainfall decreased at 8 weeks after emergence for long period (4 weeks).

For cotton, system 3 gave the highest total net income, though this was not statistically different from that of system 2 (Figure 4).

When compared to system which gave the highest total net income in 1995, they had something in common including; first, plants which used in the systems were table corn, peanut and Sri Sumrong 60; second, cotton spacing was 1.5 m x 0.5 m, two plants per pill; third, corn hill spacing

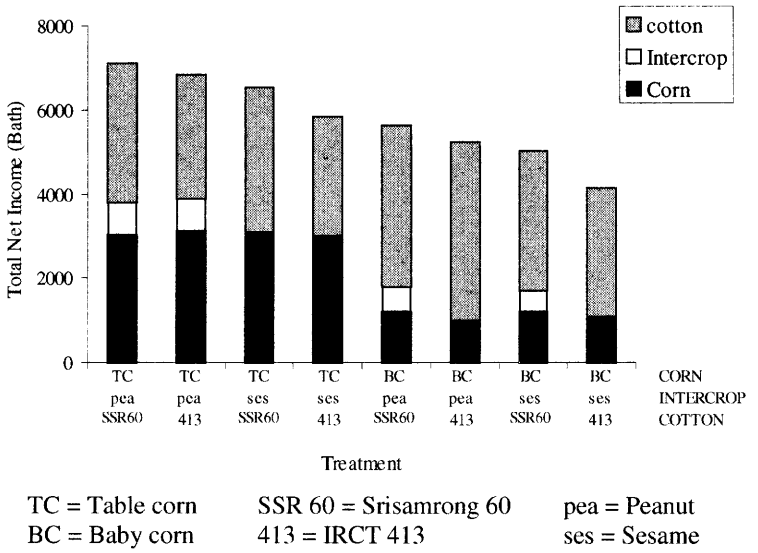

Figure 2 Total net income and net income of each crop in 1995 when soybean and sesame were planted between rows of table corn or baby corn followed by planting cotton variety SSR 60 and IRCT 413 in 8 different systems.

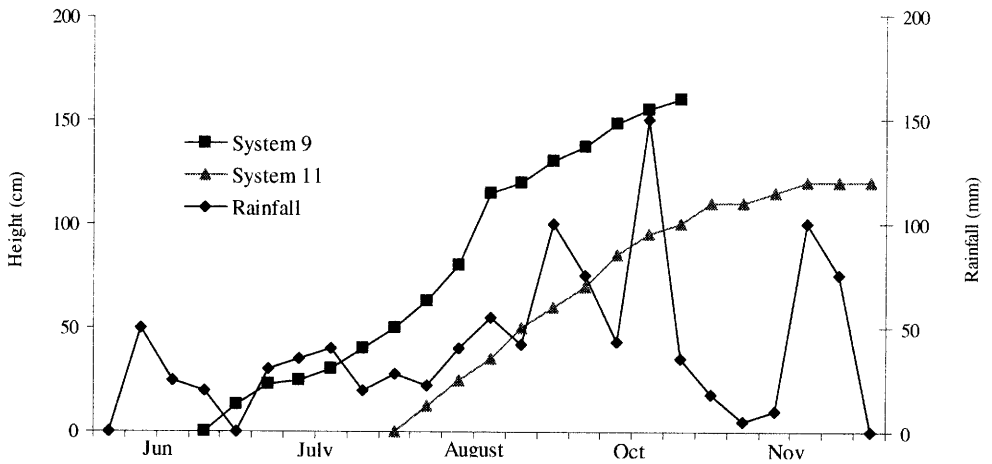

Figure 3 Height of cotton plant of system 9 and system 11 and rainfall during growing season in 1996.

was 25 cm, one plant per hill. What differed were corn row spacing, plant in which peanut intercropped, peanut population and duration of cotton grown under corn and intercrops. Peanut population density for 1996 was 2.50 times greater than 1995 whereas net income was 2.43 times greater (2,084 compared to 857 Bahts). Though cotton variety and spacing were the same in these two years but early growth in 1996 might be limited because they were grown under nearly full grown

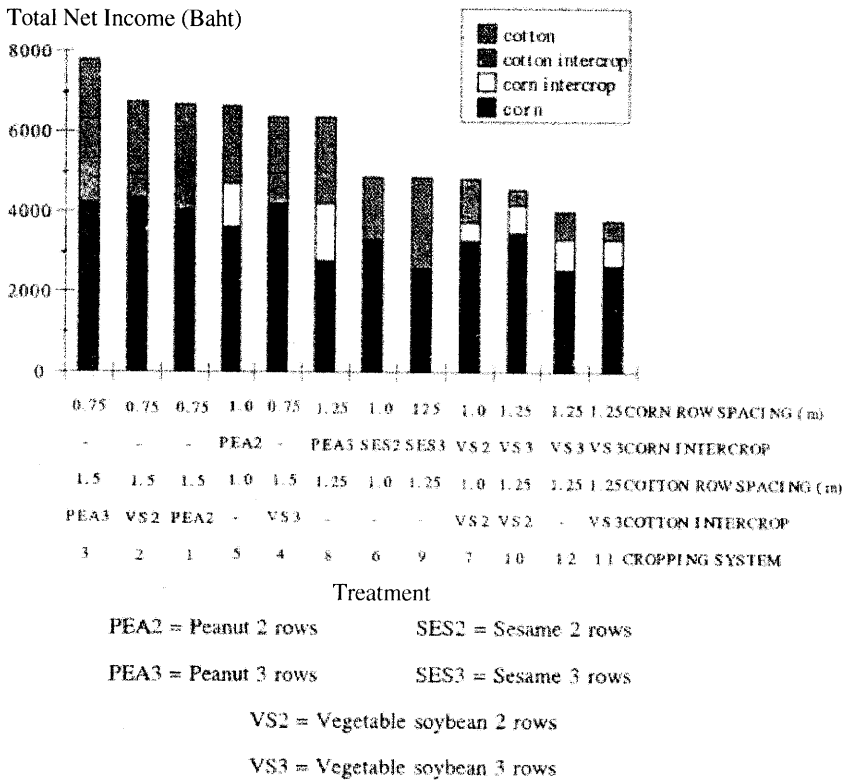

Figure 4 Total net income and crop net income of 12 maize-cotton cropping systems in 1996.

corn and 58 day-old peanut and these resulted in approximately 50% reduction in cotton net incomes. Therefor, mentioned advantages and disadvantages should be considered before adding other crops to corn-cotton relay cropping system.

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